

GENERATE A REPRESENTATION OF AN OBJECT IN GRAPHIC SPACE SENSE THE POSITION OF THE USER IN REAL SPACE 22 DETERMINE THE HAPTIC INTERFACE POINT IN GRAPHIC SPACE 24 DETERMINE THE FIDUCIAL OBJECT POINT IN GRAPHIC SPACE 26 CALCULATE A STIFFNESS FORCE TO BE APPLIED TO A USER IN REAL **SPACE** DETERMINE THE VELOCITY OF THE HAPTIC INTERFACE POINT 30 DETERMINE THE VELOCITY OF THE FIDUCIAL OBJECT POINT 32 CALCULATE A DAMPING FORCE TO BE APPLIED TO THE USER IN REAL SPACE 34 CALCULATE A FEEDBACK FORCE TO BE APPLIED TO THE USER IN REAL **SPACE** 36

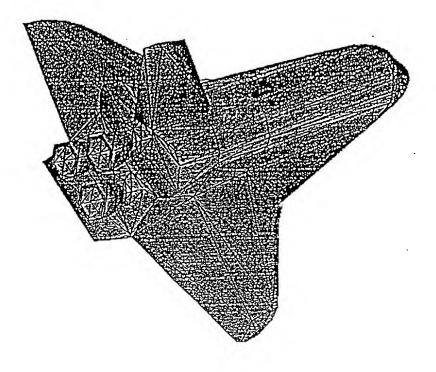
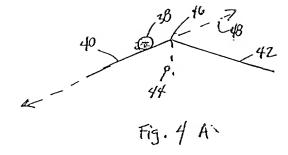
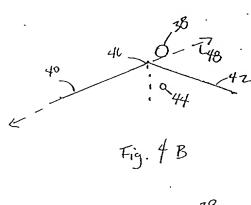


Fig. 3





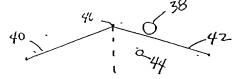


Fig. 4 C

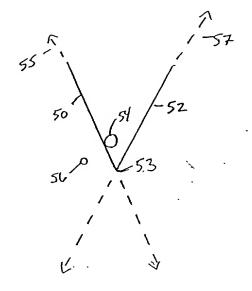


Fig. 5A

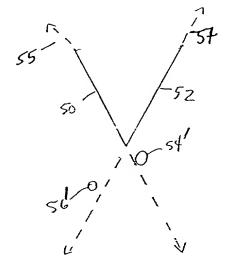


Fig. 5B

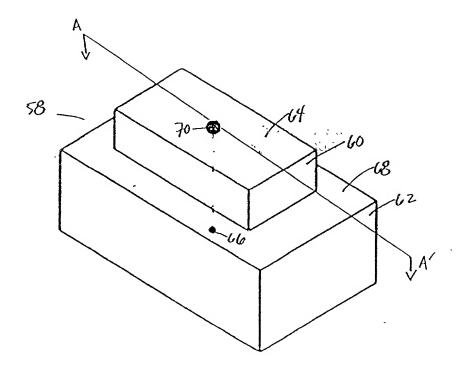


Fig. 6 A

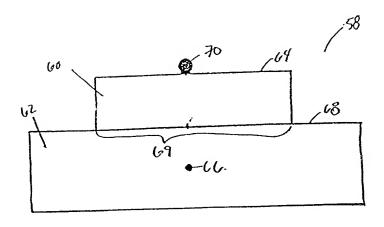
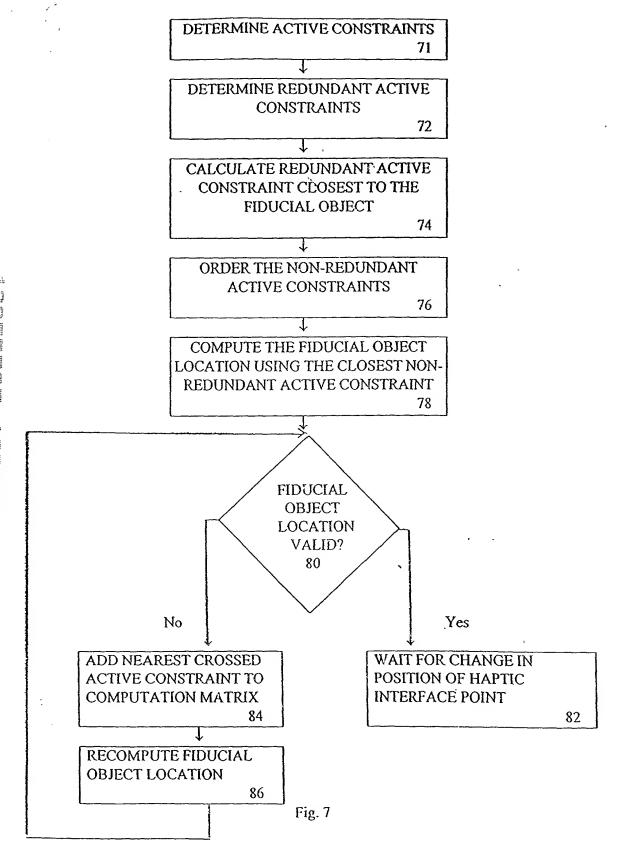


Fig. 6B



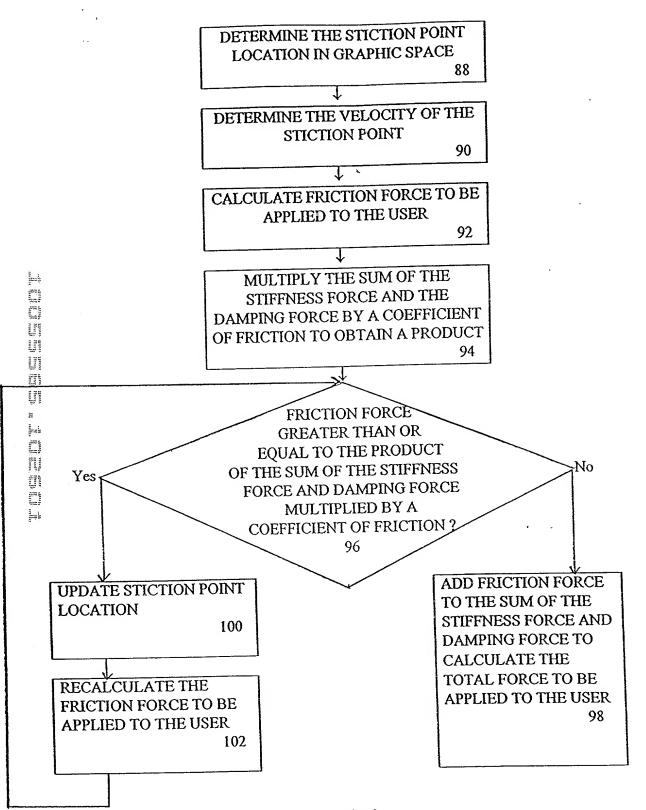


Fig. 8

Us Fromed X, t

Fig. 9

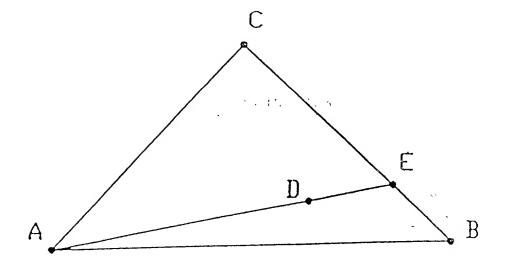


Fig. 10

DEFINE OBJECT AS A MESH OF PLANAR SURFACES

104

ASSOCIATE A PARAMETER VALUE WITH EACH NODE OF EACH PLANAR SURFACE

 T

106

DETERMINE ON WHICH PLANAR SURFACES THE FIDUCIAL OBJECT POINT IS LOCATED

108

COMPUTE THE PARAMETER VALUE
FOR THE FIDUCIAL OBJECT POINT
LOCATION BY INTERPOLATING THE
PARAMETER VALUES ASSOCIATED
WITH THE NODES OF EACH SURFACE
ON WHICH THE FIDUCIAL OBJECT
POINT IS LOCATED

110

DESCRIBE THE SURFACE OF THE OBJECT USING A COORDINATE SYSTEM

112

ASSOCIATE A PARAMETER VALUE WITH EACH SET OF COORDINATES 114

DETERMINE WHICH SET OF
COORDINATEŞ DESCRIBES THE
FIDUCUAL OBJECT POINT LOCATION
116

DESCRIBE THE VIRTUAL ENVIRONMENT USING A COORDINATE SYSTEM

117

DESCRIBE THE SURFACE OF THE VIRTUAL OBJECT USING A COORDINATE SYSTEM

118

ASSOCIATE A DISPLACEMENT FORCE WITH EACH SET OF COORDINATES OF THE TEXTURE MAP

120

ASSOCIATE A SURFACE NORMAL WITH EACH SET OF COORDINATES OF THE PLANAR SURFACE

122

ADD EACH DISPLACEMENT FORCE TO THE CORRESPONDING SURFACE NORMAL TO CALCULATE A TOTAL SURFACE NORMAL FOR EACH SET OF COORDINATES

124

DETERMINE WHICH SET OF COORDINATES OF THE PLANAR SURFACE REPRESENTS THE FIDUCIAL OBJECT LOCATION

126

CALCULATE TOTAL FORCE TO BE APPLIED TO THE USER IN REAL SPACE

128

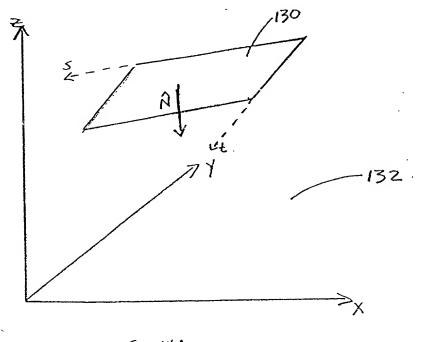


Fig. 14A

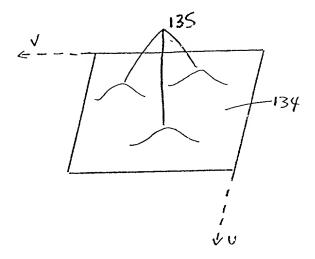


Fig. 14B

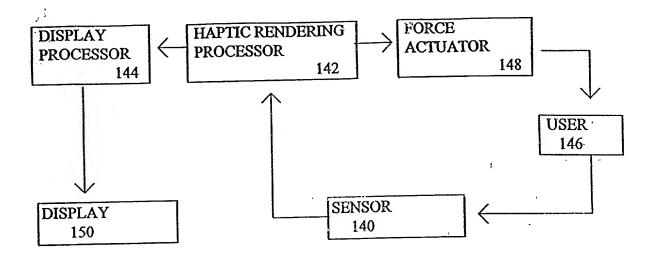


Fig. 15